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ABSTRACT

This guidebook focuses on the final step included in a five-step planning system for improving local secondary and postsecondary programs and facilities accessibility: removing barriers. The guidebook is comprised of self-instructional discussions of three techniques that can be used in planning for implementation of barrier-removal strategies: (1) Force Field Analysis, (2) Management-By-Objectives, and (3) Program Evaluation and Review Technique. Within each of these three sections, the strengths and limitations of the technique are analyzed, examples are provided concerning when the technique should be used, required resources and materials are given, and implementation strategies are provided. (LRA)

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Access to Vocational Education

A Planning System for Local Secondary and Post-Secondary Program and Facility Accessibility

Step 5

Removing Barriers

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Step 5: Removing Barriers

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Suggested Techniques for Assisting in Removing Barriers to Program and Facility Assessibility

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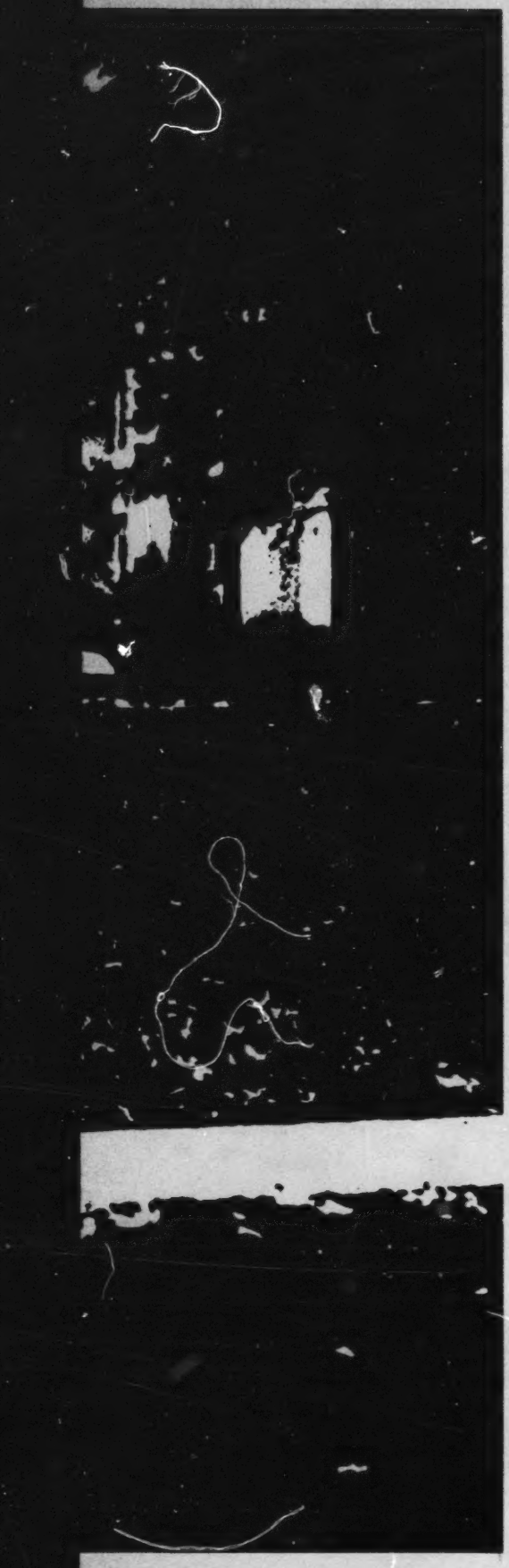

Introduction

The fifth step of the Planning System, Removing Barriers, has been designed to assist you in organizing resources to implement strategies for removing barriers to program and facility accessibility. Planning for implementation is both time consuming and necessary and has few shortcuts. As mentioned in the Guide, implementation requires attending to goals, objectives, expenditures of dollars, time, timing, record keeping, evaluation, personnel and politics, among other factors. You, as program administrator, must manage successfully each of these items in order to assure effective implementation of selected strategies for removing barriers and creating accessible programs.

How to Use This Booklet

This Step 5 booklet contains self-instructional discussions of three techniques that you can use in planning for implementation of barrier removal strategies. The three techniques are Force Field Analysis (FFA), Management by Objectives (MBO), and Performance Evaluation Review Technique (PERT). Each of the techniques can be used to generate information when planning for strategy implementation for barrier removal or can be applied to any aspect of the implementation strategy. For purpose of illustration, the discussions of two of the procedures, FFA and MBO, have been written as if the techniques were to be used to plan initial strategy implementation while the discussion of the third technique, PERT, has been written as if it were being used to plan an evaluation of a strategy for barrier removal that had been implemented.

For purposes of discussion, assume that one of the strategies developed by the Tigris School District LPC, that of creating a related instructional aide program for all regular vocational classrooms, was adopted as one way of eliminating the identified barriers. How could the suggested technique be useful in implementing this strategy?

Force Field Analysis

Force Field Analysis (FFA) is a technique for focusing group discussion on the forces operating for and against the realization of a particular goal or possible solution of a particular problem. A force is any physical, organizational, emotional, or attitudinal circumstance which must be considered in making a decision in a given situation. For example, in deciding whether to arise in the morning one might consider some of the following forces: (1) the need to go to work, (2) hunger, (3) the weather outside, (4) the weather inside (room temperature), (5) the need to awaken other people, (6) length of sleep, (7) distance from bed to the alarm cut-off. As demonstrated by the example, Force Field Analysis is a good way to analyze and to generate information about potential solutions that have been defined.

Force Field Analysis is based on the holistic psychology of Kurt Lewin who believed that a network of factors or forces affected an individual, especially when an individual was making a decision. Lewin was interested in all such factors including the form of government in which the person lived; the kind of work they did; the family from which they sprang; and the kinds of dreams and ambitions they cherished. Lewin made elaborate diagrams of the "life space" or "psychological space" of a given individual. He had hoped to assign each of these forces a weight or value and, from such weighing, to predict what people would do in given situations.

The results of a group meeting using Force Field Analysis will provide you as administrator with a more complete description of the forces operating in your educational unit for and against the various alternate ways to implement the strategy you have selected. Some of the forces should be new to you since the group contributing to the Force Field Analysis represents a necessarily broader perspective than one individual. The Local Planning Committee is the group recommended for use. The group also will suggest the long range effects on the organization and organization members for each of the alternative means of implementation. Information generated about attitudes and values is the most valuable output of the analysis because it is information that is difficult to obtain in other ways.

The mental activity required of members in the Force Field group may best be described as:

a. inductive reasoning
b. deductive reasoning
c. analysis
d. synthesis
e. creativity

Answer: c.

One advantage Force Field Analysis has over other techniques is that some kinds of information are more readily collected in this kind of group than in other groups. What kind of information is more accessible?

a. dreams and ambitions
b. long-range outcomes
c. important technical problems
d. hidden costs
e. attitudes and values

Answer: b. & e.

STRENGTHS AND LIMITATIONS OF FORCE FIELD ANALYSIS

Force Field Analysis has been demonstrated to be a useful technique for wrestling with human service problems in a variet of settings including schools, community relations, government and business and industry (Lippitt and Lippitt, 1978). FFA also has been demonstrated to work effectively in conjunction with other group planning techniques as a procedure for investigating alternative solutions to problems or as a means of collecting information to use in mapping out strategies to revise programs (Paul, Turnbull and Cruickshank, 1977).

FFA has broad applicability to planning issues and can be used to analyze problems, goals or solutions to problems. It is recommended in these materials as a technique for dealing with implementing potential solutions to the problem of inaccessibility. Among the advantages of this technique are (1) the requirement to utilize many people within the community as resources, (2) the way the technique "depersonalizes" the forces, thus increasing group commitment to and focusing on the question addressed, and (3) the ability to compile a comprehensive list of all the forces, particularly the subjective ones, which affect the realization of some goals.

Choose items among the following that are advantages of using Force Field as a technique for planning for strategy implementation.

a. suitable to many situations
b. taps the ideas of many people
c. avoids conflict over sources of problems
d. reveals attitudinal dimensions of the problem

Answer: d.

FFA has several limitations. Despite its availability for over 30 years, very little research has been done on it. Only the recommendations and opinions of those who have tried it are available.

A more critical potential limitation is group membership. The personnel of a Force Field Analysis group affect the output. The effectiveness of the technique depends to some degree on the skill of the leader to develop a climate of trust in which individuals feel free to express negative as well as positive views so that the results are authentic. The leader also must be patient and wait for participants to generate the long-range effects of different courses of action. In addition, participants must be truly knowledgeable about the subject in question or the results of the analysis will be inadequate.

One additional limitation of FFA is the failure of the technique to rank order by importance the identified positive and negative forces. Descriptions of the technique mention only listing the forces without prioritization. Without rank order by importance of the forces, planning for use of positive forces to overcome potential negative factors becomes more difficult. The suggested adaptation of FFA in these materials provides for working with the most important suggested forces.

How much research has been done on Force Field? (Mark one)

A Great Deal — Much — Some — Very Little — None

Answer: Very little or none

Often people who use Force Field omit the final important step. What is that step?

Answer:
Prioritizing forces according to level of importance.

WHEN SHOULD FORCE FIELD ANALYSIS BE USED?

Force Field Analysis is appropriate any time a thorough diagnosis of the "helps" and "blocks" associated with a particular solution or strategy is needed. Use of the technique is appropriate also when a complete and accurate list of positive and negative factors related to a solution is needed. It works best when considering one possible strategy or solution at a time. Force Field Analysis is also a good method for an outside consultant to use to collect information about the organization with which the consultant is working (Lippitt & Lippitt, 1978). FFA also is useful after initiating a strategy to remove barriers as a formative evaluation technique to identify forces which may enhance or impede the continued progress of implementation. It could prove particularly valuable in barrier removal when used in this way.

In which of the following situations would Force Field be most appropriate?

a. lots of ideas are needed in a hurry
b. a thorough description of all advantages and disadvantages of different options is desired
c. an overall working model or plan is desired
d. different strategies need to be weighed, assigned a value and one chosen
e. lots of input and information from many different sources is needed to begin to define the dimensions of a problem

Answer:
b.

RESOURCES AND MATERIALS REQUIRED

A Force Field Analysis requires the participation of a leader and six to ten knowledgeable people, "knowledgeable" meaning those involved have some experience with the problem and potential solution under consideration. The LPC is a possibility for use in the FFA. A comfortable room with walls on which newsprint can be mounted is required, along with marking pens, newsprint and masking tape. If more than ten people are involved, form two groups and find a larger room or two rooms. A Force Field Analysis may take three hours to two days; the length of the session depends on the nature of the problem. Longer sessions tend to allow the group to address the long-range effects of the solution they are considering. If the information generated in the other steps of the Planning System is good, the FFA should require three to four hours.

How much would a Force Field Analysis cost your school system?

a. How involved are the solutions suggested for dealing with the problems in providing vocational education for the handicapped in your system?

Very Simple — Very Complicated

b. How many days should you allow for the group meeting?

½ day 1 day 2 days 3+ days

c. List persons in your system who should be involved, including teachers, administrators, parents, students, employers, rehabilitation counselors, school board members, etc. You may consider using your LPC but it is not required.

_____ _____

_____ _____

_____ _____

_____ _____

d. Will you need an outside person to lead the group?

Yes _____ No _____ Cost per day _____

e. Will you have to rent space for the group meeting?

No _____ Yes _____ Cost per day _____

Now, the total cost will be:

# days		Cost per person		Cost for leader		Cost for facilities		TOTAL
$ _____	×	$ _____	+	$ _____	+	$ _____	=	$ _____

HOW TO CONDUCT A FORCE FIELD ANALYSIS SESSION

All members of the group should be knowledgeable about the program under consideration; they will be briefed on the solutions or strategies to be addressed in FFA as the session begins. Consumers are particularly important members of FFA groups.

The leader must be comfortable directing the group's activity. Knowledge of the problem is less important than human relations skills. However, the leader must understand the thrust of the solution or solutions to be considered. An information seeking attitude on the part of the leader will contribute to the description of those forces that may be obvious to group members who view the solutions from a different perspective.

Who in your community and educational unit would have important information or knowledge to contribute to a Force Field Analysis of teh potential solutions for making vocational education accessible to handicapped students? (List)

_____ _____

_____ _____

_____ _____

_____

Assuming that you are leading the FFA group, you will begin the meeting by briefly introducing the concept of Force Field Analysis and describing what the group should accomplish through implementing the procedure. On the basis of participants' questions, a practice session of very short duration (on the topic of how to quit smoking, for example) could be conducted. Moving on to the main topic, after clearly stating the nature of the problem and solutions to be addressed, the leader instructs the group to first list all the restraints or blocks which represent the forces perpetuating the problem and interfering with the proposed solution. The leader records all these forces on newsprint taped to the wall. Then the leader directs participants to list all the "driving forces", those operating to change the situation or solve the problem by implementing the solution. The leader records these ideas and posts them to the left of the list of restraints. Some relaxation of this order has been advocated by later proponents of FFA who allow "simultaneous brainstorming" of both lists (Lippitt & Lippitt, 1978).

After the original lists have been generated, the idea is to mitigate or remove the items on the negative forces list. A force field group is naturally inclined to add to the list of driving forces first and only later to try to remove the restraining forces. The leader should encourage group members to remove the restraining forces *first* because, as Lewin himself cautioned, removing restraints *does not precipitate an equal and opposite reaction in the environment or precipitate new problems.* Thus, the solution will be more easily accepted and will not generate additional problems.

The group should have enough time to include in the lists some of the positive or negative effects of a particular alternate on the people or program operations in the future. If several alternate solutions to a problem are to be combined, then each is considered in turn. The initial group may also be divided into smaller groups, each with one solution per small group to examine carefully.

Why should the leader concentrate the group's attention first on removing the restraining forces? _____

_____

_____

Answer:
Because removing restraints will not precipitate reactions or cause new problems.

_____

A session should occupy a minimum of two hours. An example of a three-hour session is given below.

Activity 1. (10 minutes suggested.) The solution or strategy is defined as a condition that exists or may exist with forces impinging upon it. The issue must be specific and one in which the group has an interest and some power to change. The leader must carefully guide the group to a precise definition of a problem and a strategy to be implemented.

Activity 2. (20-30 minutes.) The group brainstorms first the restraining and then the driving forces impinging on this particular strategy. In directing this activity the facilitator (leader) should encourage the free flow of ideas and discourage qualification or evaluation of responses as the leader lists responses on the wall.

Activity 3. (30-40 minutes.) Next, the group focuses on the restraining forces and attempts to arrange them in order of priority. Priorities are determined by group consensus. The leader should emphasize to participants that a number of ways of dealing with negative forces will be forthcoming and that more than one issue will be dealt with on the list.

Activity 4. (10-15 minutes.) Having defined more clearly the restraining forces and having established priorities, some items can be eliminated from the list because the group lacks the power, time, money or other resources to effect a change. This step is important because the group can then focus more energy on the restraining forces which they can do something about.

Activity 5. (40-60 minutes.) During this period the group lists specific ways to reduce the restraining forces in a manner that will minimize possible offsetting reactions. It may be fruitful for the group to break into smaller groups to consider several restraining forces and report back to the larger group. If time permits, suggestions for new driving forces may be entertained at this time.

Activity 6. (20 minutes.) More specific proposals including methods of implementation and evaluation are developed. Some few details of implementation may have to be completed later for lack of adequate information at the time.

Activity 7. (30 minutes.) (The group probably cannot be productive for more than 30 minutes after a three-hour session.) The group discusses all the specific proposals and outlines an overall plan for implementing the selected solution or strategy. This is an important step for obtaining the commitment of participants for implementing the programs they have proposed and for obtaining assurance of interagency cooperation where it is needed. A followup steering committee may be appointed at this time.

Activity 8. (Estimated time is left to the individual leader.) The group agrees on a date and time for a future meeting in order to report back and evaluate the plan proposed.

Below are the eight steps involved in a Force Field Analysis. Order them correctly by placing the numbers 1 to 8 in the blanks provided.

____ a. arrange restraining forces in rank order
____ b. discuss all forces and outline overall plan for implementing solution
____ c. eliminate those restraining forces which the group cannot change
____ d. brainstorm restraining and then driving forces
____ e. agree on a date and time for a future meeting
____ f. list specific ways to reduce restraining forces which minimize offsetting reactions
____ g. leader guides a precise definition of the problem and suggested solution(s)
____ h. develop specific proposals for implementation and evaluation

Answer: 3,7,4,2,8,5,1,6.

The above outline represents a sample time frame for a Force Field Analysis meeting. For a fairly complex set of solutions, three hours is not too short a time to spend at this activity. Any modification of the procedure which maintains the sequence of activities suggested above would be acceptable to the proponents who developed the technique; integration of Force Field into a larger planning process is considered an appropriate use of the method.

ADDITIONAL RESOURCES

To learn more about Force Field Analysis one should first read Lewin (1951). R. Napier's Groups: *Theory and Experience* (1973) and Lippitt and Schindler-Rainman's *Team Training for Communicaton Change: Concepts, Goals, Strategies and Skills* (1972) offer more succinct descriptions of the technique. For a description of how Force Field is used in conjunction with other techniques see Paul, Turnbull and Cruickshank (1977). Current modifications of the technique are available in Lippitt & Lippitt's *The Consulting Process in Action* (1978).

Management-By-Objectives

One problem in implementing strategies to solve problems and overcome barriers is resistance to change on the part of those organizational members who hold critical roles in implementing the strategy for change. Managers and administrators have long been aware that when role occupants are affected by decisions that the role occupants did not participate in making, too often the resulting decisions fail to achieve intended impact either because of passive resistance or open rejection and hostility. A technique for strategy implementation which actively takes this fact into account is Management-By-Objectives (MBO). Rather than viewing the "human" factor in management and administration as evil, MBO faces it squarely and capitalizes on it both during the decision-making phase and during the implementation phase.

MBO involves mutual goal/objective setting for strategy implementation by the administrator and the teacher. Either may prepare the objectives but it is crucial that both parties agree upon them. Key components of the process are the statement of the desired activity in specific terms, who is responsible for performing the activity and when the activity will be performed. It is helpful as well to include a monitoring device to insure that progress toward objectives is proceeding according to schedule. At the end of the predetermined time, resulting performance is measured against the specified objective(s).

MBO was first developed and applied in an industrial setting as an outgrowth of the movement toward rational management. Its initial formulation is attributed to Peter Drucker who is reported to have first used the term in his 1954 edition of *The Practice of Management* (Hacker, 1973). MBO assumptions are few and straightforward. Goals and objectives must be sufficiently concrete to be identifiable and clearly stated and they must be measurable.

Let's pause a moment to review before continuing. Place a check beside the items below that are accurate descriptions of MBO.

a. MBO is a technique initially developed in the human services field.
b. In order to be successful, objectives must be written and developed by the supervisor.
c. Objectives must be stated in measurable terms.
d. MBO involves mutual goal-setting by the supervisor and supervisee.

Answer:
c and d.

Key components of the MBO process are statement of the desired activity, who is responsible for performing the activity, and (Fill in the blank) _____

_____

Answer:
When the activity will be performed

_____

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It is not only desirable but necessary in order to insure optimum performance that staff be involved in the process of setting goals and objectives. The technique is based on the assumption that staff who are personally involved in creating their own goals, objectives and tasks will work enthusiastically to achieve them. The human element must not only be recognized in implementing strategies to achieve goals but also must be built into the decision-making mechanism. Personal variables are not viewed as an undesirable side effect but are key forces in the work environment that can be strengthened and used productively.

MBO, in its most useful form, involves a systemwide effort for the educational unit. It involves a careful and thorough analysis of the unit's needs and goals and the development of individual needs, goals and objectives. If the effort is successful, there is a satisfactory fit between the individual and the system. Viewed in this way, MBO can be conceptualized as a planning tool, a way of implementing future strategies and solutions for individuals that leads the educational unit in the direction of its overall goal of program accessibility.

MBO is most useful when it involves a(n) (individual, systemwide) effort. (Circle one)

In order for the objective-setting process to succeed, it is (necessary, desirable) for the effort to be mutual on the part of the supervisor and supervisee (Circle one.)

Answer: systemwide; necessary

STRENGTHS AND LIMITATIONS OF MANAGEMENT-BY-OBJECTIVES

By spelling out precisely what it is people are to do and when they are to do it, performance can be significantly improved. Further, management and personnel relations may improve through cooperative involvement and mutual acceptance of goals and tasks. In this sense, MBO can facilitate change through cooperative involvement in the change process.

One limitation of MBO is its dubious reputation resulting, in part, from its initial misuse in business and industry. Ignoring these mistakes, educational administrators sometimes have distorted the purpose of MBO by imposing objectives from above. Special problems result when MBO is used as an evaluation device. When used in this way, MBO can become so threatening that ongoing activities may be disrupted and insignificant and trivial goals set in order to insure that all objectives are maximally achieved. Finally, MBO cannot handle goals and objectives well unless they can be relatively easily quantified and progress measured.

To the credit of the technique, in most instances where supervisors made an honest effort to incorporate the input from supervisees in a non-threatening way, the technique improved employee morale and productivity as well as management control and cost-containment.

The key to the success of MBO seems to depend on: (Check all those that apply.)

a. involvement and cooperation of supervisory staff
b. its use in decreasing staff salaries while increasing workloads
c. its use as an evaluation device
d. the manner in which it is implemented

Answer: a. and d.

WHEN SHOULD MANAGEMENT-BY-OBJECTIVES BE USED?

MBO is appropriate as a management tool in most school settings where a commitment to and acceptance of the solution or strategy for barrier removal exists. In an environment highly charged with suspiciousness and mistrust of the administration, implementation is likely to fail unless a great deal of relationship-building has taken place beforehand. In the past, administrators have found MBO to have been helpful where a need exists for the creative and imaginative allocation of personnel. It also has proved useful in educational units where a high level of change is to take place because staff input is desirable and cooperation is necessary for change to result in favorable outcomes.

In what settings should MBO be used?

Answer:
In settings where there is a commitment to strategy implementation and good communication.

RESOURCES AND MATERIALS REQUIRED

The only direct cost of implementing MBO in an educational unit is the time and effort expended in conferences with staff. If the procedure is to be implemented systemwide and from bottom to top as is often suggested, the total number of hours expended may be as great as one hour per staff member. The length of time these individual conferences require is highly variable and may depend, in part, on how well the supervisor and staff members communicate, how well thought-out the staff member's goals and objectives are before entering the conference, and how much change from the status quo suggested strategies or solutions for barrier removal require. As a general rule-of-thumb, you may wish to budget from 30 minutes to one hour per conference per staff person.

No materials are required for the implementation of MBO except the usual paper, pencils and typewriter for recording objectives. It is important that the conference take place in a room where privacy can be insured. Equipment needs may arise from the content of the objectives. For example, if the unit's and the teacher's objective for the year is to increase the level of reading proficiency in class by 40%, it may be decided that a reading machine is the appropriate means for achieving this goal. The appropriate method for figuring dollar cost for the basic procedure (if such information is required) is to use prorated hourly salaries of those involved as a means of placing a value on time expended.

What is the direct cost of implementing MBO?

Answer:
Conference time of staff.

HOW TO IMPLEMENT THE MANAGEMENT-BY-OBJECTIVES TECHNIQUE

There are three major implementation phases in using MBO: (1) pre-planning, (2) planning for information, and (3) implementation. Each will be discussed in turn.

Activity 1: Pre-Planning. Before implementation some planning must occur. This planning should be based upon considerations about the strategies selected to remove barriers and characteristics of the educational unit. The planning must include consideration of the following factors:

A. Decide how many people are to be involved. It is recommended that all staff affected by the proposed strategy for barrier removal be included. Decide if this is feasible and name those staff to be involved in the process.

B. State the objectives of your effort. What do you hope to accomplish with MBO in terms of selected strategies to overcome barriers to accessibility? Write your objectives in behavioral terms, if possible, so that you may make some judgment as to the success of your efforts.

C. Decide when the strategy implementation will occur. Since objective-setting represents a planning effort, strategy implementation might be most timely either at the end or the beginning of a school year, semester or quarter.

D. Once you have decided on a general time, determine how long strategy implementation will take and decide on a starting date and a date by which the effort is to be completed.

E. Hold a meeting of all department heads, managers and supervisors who are directly responsible for the work of one or more people. Explain MBO to them in the form of an open discussion, workshop or other type of training session. (You may wish to call MBO by another name if you sense that some have negative associations with the term!)

Be careful that you listen carefully for apprehensions or misunderstandings during this session. Even if only one person misinterprets the intent of the technique at this point, it may be communicated to countless others and result in failure.

Spell out clearly what is expected of everyone and check carefully to see that all questions have been answered.

F. Check your organization to see that things are running as they should. In an environment where roles and expectations are poorly defined, leadership is diffused, and communication is poor, it will be difficult to accomplish even the most unambitious objective. *In other words, check to see that your school is a place where it is possible to do what needs to be done in terms of implementing the strategy for barrier removal.*

Once you have completed your preliminary thinking about the items listed above, complete the following worksheet.

MBO
WORKSHEET

1. What do you hope to accomplish by implementing MBO?

2. Refer to #1. See if you can transform this statement into measurable objectives. Add others as they come to mind.

   a. _____

   b. _____

   c. _____

3. Who will participate in MBO? List them by department, name or any other identifying information.

   Supervisors _____ _____ _____

   Teachers _____ _____ _____

   _____ _____ _____

   _____ _____ _____

   Total Number Participating _____ _____ _____

4. Time of year when MBO will occur: _____

   _____ Date MBO will begin

   _____ Date MBO will be completed by all departments

5. Hold meeting/workshop of supervisors who will implement MBO. List major problems you may encounter in implementation of strategy as a result of feedback from the supervisors. Once this is done, list possible ways of dealing with problems.

Problems	Ways to Overcome
_____	_____
_____	_____
_____	_____

6. Check your organizational climate and structure. Collect enough information about your educational unit to answer these questions:

   Yes/No a. Are roles clearly defined? Do people know clearly what is expected of them and others?

   Yes/No b. Are communication channels relatively open and unencumbered?

   Yes/No c. Would you describe the prevailing school atmosphere as one of trust rather than mistrust?

   Yes/No d. Is leadership strong in your school? Do people have the authority to perform to the letter of their job descriptions?

If you answered "No" to any of these questions, you may have a problem which may result ultimately in the failure of your MBO effort. Take each question to which you anwered "No" and, in consultation with other administrators, supervisors, department heads and staff, design methods for overcoming these problems.

_____

Activity 2: Planning for Implementation. MBO efforts will be initiated by the entire supervisory and administrative staff. Each supervisor and supervisee should list their objectives with regard to the proposed strategy for removing barriers before entering an MBO conference. All objectives should appear in the form of stated objectives (in measurable terms), techniques for accomplishing objectives, measurement techniques and tentative time by which each objective is to be completed. In addition, each component of the MBO process should list a person who is responsible for seeing that it is carried out. Use the form, Management Objective Form, as a guide for writing objectives.

Before continuing, look carefully at the components of the Management Objective Form to be sure you understand the types of information requested. The following discussion addresses each part of the Form in step-by-step fashion.

A. Objectives:
Should be stated in such a way that each answers the questions who, where, when, what, how, and how much.

Example:
Mr. Smith will increase the skill levels (what) of disabled students in his Typing I class (who) at Tigris High School (where) by 70% (how much) during school year 1980-81 (when) through constructive use of the instructional aide strategy (how).

Note that in the above example, the questions who, where, when, what, how and how much are answered. objective should also list a person responsible for its completion. In the above example, it is Mr. Smith.

B. Techniques for Achieving Objectives:
Using the same example, the following techniques can be used to achieve it. Remember, the overall strategy is the use of an instructional aide in each classroom to improve instruction. Techniques for utilizing the aide include:

1. Purchase braille typewriters for the visually impaired
   Alternative—Purchase regular typewriters with raised characters on keys for visually impaired students.
   (Persons responsible) Mr. Smith and Ms. Willis (program head)

2. Develop a set of audio instructional cassettes for student use at home, during study periods and after school as well as during class in conjunction with the instructional aide.
   (Persons responsible) Mr. Smith and Ms. Willis (program head)

3. Initiate a 15 minutes a day individual session with each disabled student using the aide.
   (Persons responsible) Mr. Smith and Ms. Willis

Did you notice anything unusual about the way technique #1 is stated? An alternative is listed to give the supervisor, Ms. Willis, some management discretion in the event that her request for braille typewriters is denied. It is not only possible but a good idea as well to list alternatives for objectives and techniques whenever possible to build in flexibility and decrease the likelihood of failure should the objective or technique prove too ambitious or should roadblocks occur.

C. Procedures for Monitoring Progress:
Below are listed several techniques that could be used to monitor progress toward program objectives.

1. Check with business manager to see that purchase orders are completed correctly.
   (Person responsible) Ms. Willis

2. Check with program head to see that Approval for Purchase forms have been completed and signed.
   (Person responsible) Mr. Smith

3. Send two aide-prepared units per week to be recorded by the electronics program.
   (Person responsible) Mr. Smith

4. Check to see that recording is completed on time and that quality is acceptable.
(Person responsible) Mr. Smith

5. Monitor individual sessions for first two weeks and change format as needed.
(Person responsible) Ms. Willis

It is important to have some means of measuring the progress toward your objectives.

D. Procedures for Measuring Progress:

Look again at the original example and consider ways to measure progress toward accomplishment of the objective. There are instances where you may wish to develop measurement techniques for each technique to achieve the objective. In this example, the monitoring devices are sufficient measurement procedures. Also, the techniques to achieve the objective merely represent means to an end, which is the objective. It is progress toward that end that should be measured. Consider these alternative measurement procedures for the suggested objective.

1. Periodic tests of skill, speed and composition administered to students.

2. Daily reports of progress from teacher aide.

3. Weekly checks of progress on audio cassette material.

4. Grades on projects such as letter composition.

5. Reactions of students to individual work sessions.

The same general procedure and format applies to developing management directions at all levels. The Management Objective Form will aid you in developing these objectives.

MANAGEMENT OBJECTIVE FORM

Management objectives should be written in a clear and organized form like the one below. This form is intended only as a guide. Adapt it for your own use.

Objective ____ Person Responsible ____

Techniques for Achieving Objective (Task) ____

1. _____

2. _____

3. _____

Procedures for Monitoring Progress

1. _____

2. _____

3. _____

Ways of Measuring Progress

1. _____

2. _____

3. _____

Date for completion: _____

Objective written by: _____

_____

Activity 3: Implementation. Now that you have completed your planning for use of MBO you might use the following outline to guide the implementation of your MBO.

Task 1.
All supervisors write performance objectives for implementation of barrier removal strategy. Use the format outlined in the Management Objective Form.

Task 2.
All supervisors meet with their superiors and discuss the objectives they prepared in Task 1. Modify them as necessary, making sure the changes are agreed upon by both parties. Include dates for completion of each objective and techniques for achieving objectives where possible.

Task 3.
All supervisors meet with their supervisees as a group. Explain the purpose of MBO and ask supervisees to develop their own objectives in preparation for a future individual meeting with the supervisor. Explain the format and distribute and explain the Management Objective Form which supervisees can use as a guide.

Task 4.
Supervisors meet individually with each supervisee to discuss

objectives they prepared in Task 3. Make sure that all modifications are mutually agreed upon. Remember that any change in behavior can be written as a performance objective.

Task 5.
Once objectives are written, discussed and agreed upon, schedule at least two other meetings for each employee in order to monitor progress and check for performance/ procedural difficulties. It may be necessary to update objectives as the year progresses.

Task 6.
Each person who wrote objectives should prepare a year-end Accomplishment Report which should be discussed with the supervisor.
The Report should include a quantitative statement of progress achieved and possible reasons for goals being met or not being met.

Task 7.
Prepare a new set of objectives for the coming year.

ADDITIONAL RESOURCES

"Management by Objectives, Techniques for the Principal" by A. P. Mataliano *NASSAP Bulletin*, October 1972, is recommended as a practical readable guide for implementing MBO in an educational unit. The article addresses "how to", "pitfalls", and cites several examples.

STUDENT
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4 5 6
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Program Evaluation and Review Technique

Too often estimating time, cost and resource requirements of strategies to remove barriers is no more than unsystematic guesswork. Program Evaluation and Review Technique (PERT) is a method for controlling time and therein cost and resource allocation with the ultimate goal of a timely completion of the project without undue waste. It is a means of representing a large array of interrelated activities in a graphic format in order to facilitate experimentation with various subtask combinations. Such experimentation permits you as the user to create the set of steps that will permit project completion in the shortest possible time, at minimum cost, and with the least resource waste. Experimentation also facilitates anticipation of problems in strategy implementation and provides time to apply corrective measures.

A companion to PERT, the Critical Path Method (CPM), focuses on both costs and time requirements to complete strategy implementation. Although similar, there are general differences in approach for PERT and CPM. PERT uses three time estimates to form a weighted average of project completion time whereas CPM uses only one estimate. A further differentiation, as mentioned above, is that CPM allows for cost as well as time estimations whereas PERT deals mainly with the planning and control of time. Used together, they offer a powerful tool for coping with problems in strategy implementation and program development.

PERT and CPM are useful aids to the administrative decision-maker in answering the following questions about developing a program or implementing a strategy to remove barriers to program and facility accessibility.

- What activities are necessary for successful completion of strategy implementation?
- Which activities must be completed on time in order for the strategy implementation to be completed on schedule?
- How much flexibility is possible in conducting tasks related to barrier removal?
- What is the earliest expected completion date of the implementaion strategy?
- What is the probability that the strategy will be implemented on time?
- How can delays that occur during the implementation be handled in order to insure its timely completion?

The immediate, tangible outcome of PERT is a graphical display of component strategy implementation or program development activities with time and cost projections for each. The intended intangible product is an implementation management plan with resources allocated in such a way as to insure timely completion within budget.

See if you can recall some of the major points about PERT before continuing.

PERT requires that subtasks of a project be displayed in the form of a

a. graph
b. chart
c. table
d. triangle

Whereas PERT provides time estimates of task completion, the Critical Path Method (CPM) provides for _____ as well as time estimates.

Answer:
a.) cost.

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STRENGTHS AND LIMITATIONS OF PERT

PERT has achieved popularity as a technique for saving time and money and minimizing resource waste, especially for large scale strategy implementation programs. It aids in efficiently and effectively implementing goals and objectives and can be used with practically any large project where logical planning is required. It also has the advantage of being adaptable to computer use.

The user should be aware that the time, cost and resource estimates are only as good as the thinking that produced them. PERT helps to make the process easier but not even PERT can correct for poor judgment. It can assist you, as administrator, in avoiding serious time delays but it can only suggest corrective action. The details of how to implement programs and of how to implement programs and how to follow through rest with the administrator. As a final word of caution, PERT is not applicable to repetitious tasks and is not recommended for strategy implementation programs with less than ten discrete activities. There are other techniques which are more cost-effective in dealing with repetitious or short term programs.

WHEN SHOULD PROGRAM EVALUATION AND REVIEW TECHNIQUE BE USED?

As previously stated, use PERT when your project consists of at least ten discrete activities and is non-repetitious. Additionally, you should know the following information about your project before you can apply PERT successfully:

- What is the desired end result of the strategy to be implemented?
- What are the events and activities that must occur in order to achieve the result?
- How are the events and activities of strategy implementation interrelated?
- What are the time and resource requirements for each activity? (Reasonable estimates will do.)

If you can supply this information about your project and it does not consist of simple, repetitive tasks, PERT is probably appropriate.

In education, PERT has been used with such activities as school construction projects, reorganization efforts, facilities planning, contract negotiations and task force projects. It has the added advantage of being simple to understand and communicate to others which aids in helping those involved in project work see the relationship of their effort to the total project.

When should PERT not be used?

Answer:
When strategy has repetitious tasks or less than 10 tasks overall.

RESOURCES AND MATERIALS REQUIRED

PERT is not especially time consuming or burdensome in a financial sense. One person can perform all required operations and most of the time with the sole assistance of a calculator, paper, ruler and pencil. For very large and complex tasks, a computer may be required. A wall chart can be used to display the network clearly.

HOW TO IMPLEMENT PROGRAM EVALUATION AND REVIEW TECHNIQUE

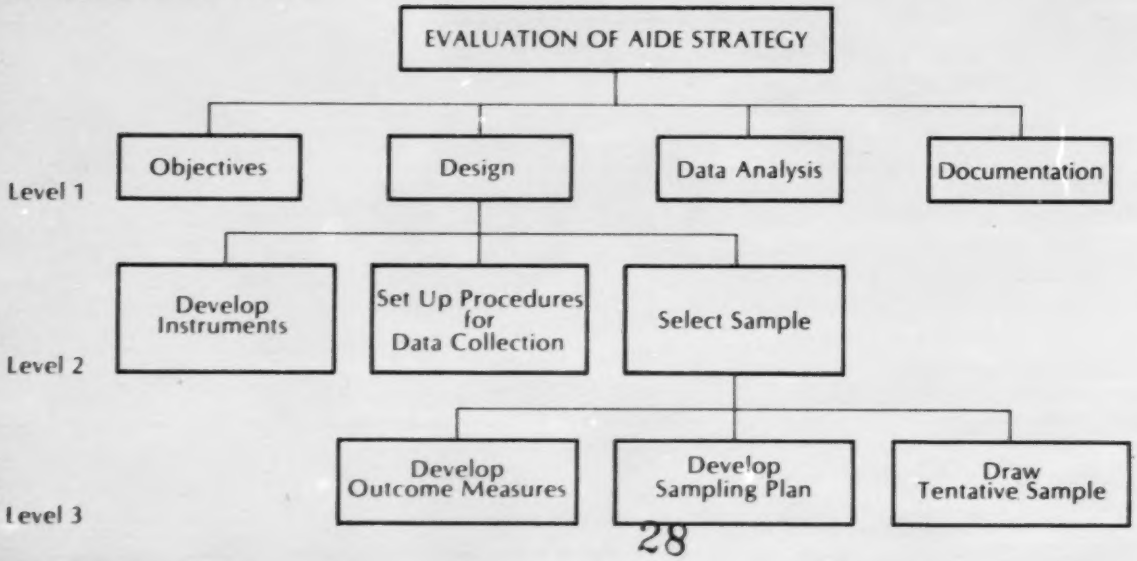
PERT is a relatively simple technique to use. Below are listed and discussed the activities in implementing PERT. For purposes of illustration, please remember the example of the strategy of use of instructional aides in the regular vocational classes of the Tigris School District. In describing PERT, assume the strategy has been implemented and in use for five months. School officials want to evaluate the effectiveness of the strategy for making programs accessible and have selected PERT as a technique for planning the evaluation.

Activity 1: List Project Objectives for Strategy Implementation. This activity, although deceptively simple, is useful in helping to identify gross implementation components in the next activity. As the project is broken down further into component tasks, it will be helpful to ask yourself how each task assists in accomplishing the project objectives.

Activity 2: Break the Project Down Into Major Work Units. This process involves dividing the project into smaller and more easily manageable chunks. It will be easier to start at the top and work down until the desired level of detail is reached. There is no need to be overly specific at this stage. You will break the components listed here into smaller units in the next step.

Please refer to Figure 1, Levels of Work Activity, in which the major work units of the project have been listed by levels from the most generated level (Level 1) to the most specific level (Level 3). Conceptualizing the project in levels at this stage is a helpful way of dividing the implementation strategy procedures into logical units.

FIGURE 1. LEVELS OF WORK ACTIVITY



Activity 3: List the Major Tasks and Events/Milestones Necessary for Completion of Strategy Implementation It is important to distinguish between tasks and events/milestones. A task is an effort which requires time and resources for completion. An *event* is or *milestone* signifies the beginning or end of a task but does not consume time. In order to reach an *event/milestone,* all previous tasks must be completed. *Events* or *milestones* can be viewed as interim goals whereas *tasks* can be thought of as means for reaching the interim goals.

When listing tasks and events/milestones, start at the end of the implementation project and work backward unless the project is simple and straightforward; in such instances, you can start at the beginning and work forward to the end. Use short, concise phrases and start events/milestones in the past tense. When tasks are listed, assign each a number. Below are listed the major tasks and milestones for the Tigris example.

MAJOR TASKS AND EVENTS/MILESTONES FOR TIGRIS EXAMPLE

Task Number	*Task Title*	*Events/Milestones*
9	Prepare final report for LPC	Prepared
8	Analyze data	Completed
7	Code data	Coded
6	Collect student grades and competency scores	Collected
5	Conduct interviews	Conducted
4	Administrator questionnaire	Completed
3	Train data collection team	Team trained
2	Order materials	Ordered
1	Develop instruments	Completed

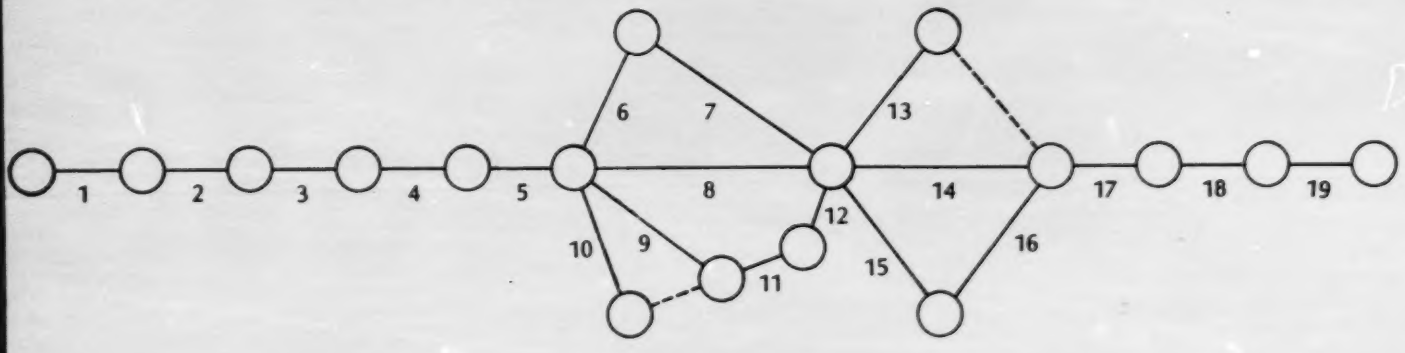
Do not be too concerned about getting proposed tasks and milestones in exact order at this stage. List them all first; order them only after you have listed all that have come to mind.

Activity 4: Determine the Sequence of Tasks and Events/Milestones. There are several ways of doing this but the one illustrated here is probably the easiest. Beside each task you have listed, write the numbers of all tasks that must occur before that task can be completed. Figure 2, Listing of Tasks with Required Preceding Tasks, illustrating this activity. In the figure, all tasks have been listed, sequenced, assigned a number and the number of the preceding tasks have been noted in the column on the far right.

FIGURE 2.
LISTING OF TASKS WITH REQUIRED PRECEDING TASKS

Task No.	*Task Title*	*Event/Milestone*	*Required Preceding Task*
1	Determine purposes and goals of evaluation	Completed	None
2	Review strategy objectives	Reviewed	1
3	Develop outcome measures for objectives	Developed	1,2
4	Develop evaluation design	Developed	1,2,3
5	Select sample	Selected	1,2,3,4
6	Set data collection time frame	Time set	1,2,3,4,5
7	Establish procedure for collection of data	Established	5,6
8	Identify personnel to collect and process data	Personnel selected	5,6
9	Develop questionnaire	Completed	5,6
10	Develop interview schedule	Completed	5,6
11	Develop coding forms	Completed	9,10
12	Order & reproduce necessary materials & supplies	Ordered	11
13	Train data collection team	Trained	5,6,7,8,9,10,11,12
14	Administer questionnaire	Completed	5,6,7,8,9,10,11,12,13
15	Conduct interviews	Completed	5,6,7,8,9,10,11,12,13
16	Collect student grades and competency measures	Collected	12,13,15
17	Code data	Data coded	13,14,15,16
18	Analyze data	Analysis complete	17
19	Prepare final report	Prepared	18

FIGURE 3.
PERT OF PROGRAM EVALUATION PROJECT



Activity 5: Construct a Network of Your Project. Recall that action flows from left to right so the beginning event/milestone will appear at the far left of your paper and the end event/milestone will appear at the far right. Events are designated by a circle or a square. The sample included here uses circles.

You can number either the task or the event. If you number tasks, place the number on the line representing the activity. Events are numbered by placing the numbers in the circle which designates the event.

Lines are used to represent tasks that lie between events. In other words, they serve to tie events together.

When a task consumes time, use a solid line. When a task does not consume time, use a broken line. A task that does not consume time is called a *dummy task*.

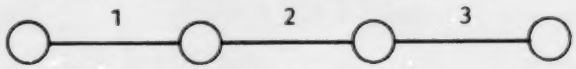
There is no need to include arrows at the end of lines except to indicate action that moves anywhere except from left to right. Lines can be any length since there is no scale. Length of line does not represent the amount of time a task consumes.

Refer to Figs. 2 and 3 before continuing. Figure 3 is a network for the suggested example. Tasks noted in Fig. 2 have been networked in Fig. 3 and the task numbers correspond. However, before you develop your own network, you need a summary of rules for network construction. These rules are presented in the following several pages in Fig. 4, Types of Network Construction.

FIGURE 4. TYPES OF NETWORK CONSTRUCTION

SERIES CONSTRUCTION

Tasks which cannot occur until certain preceding tasks have occurred may be diagrammed serially as illustrated below.



Series Construction

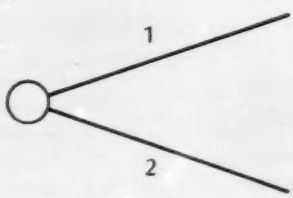
In this illustration, task 2 cannot occur until task 1 is completed and task 3 cannot occur until tasks 1 and 2 are completed.

Which tasks in Fig. 3 are serially constructed?

Answer: 1, 2, 3, 4, 5, and 17, 18, 19.

PARALLEL CONSTRUCTION

When two tasks can occur simultaneously, they are represented as parallel in the network as illustrated below



Parallel Construction

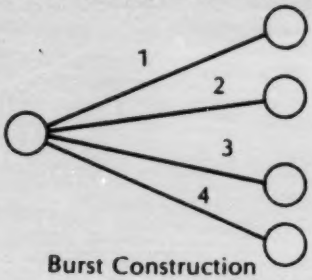
In the parallel construction illustration, notice that tasks 1 and 2 can occur at the same time.

Which tasks in Fig. 3 can occur simultaneously? Please list all sets of tasks that apply.

Answer: 6, 8, 9, 10; 7, 8, 11; 7, 8, 12; 13, 14, 15; 14 and 16.

BURST CONSTRUCTION

As the illustration of parallel and burst construction illustrate, a burst construction is used when one event precedes two or more, all of which can occur simultaneously.



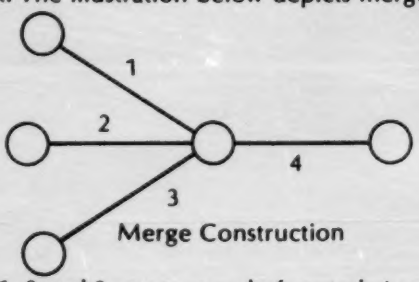
Burst Construction

In Fig. 3, which tasks represent a burst construction? Please list all sets of tasks that apply.

Answer:
6, 8, 9, and 10; 13, 14 and 15.

MERGE CONSTRUCTION

A merge construction represents a situation where several simultaneous tasks must precede one task. The illustration below depicts merge construction.



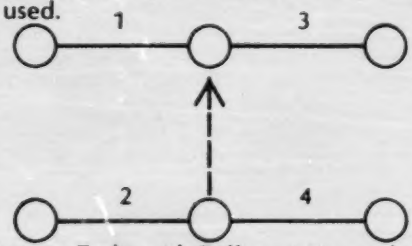
Merge Construction

Notice here that tasks 1, 2 and 3 must occur before task 4 can occur.

Which tasks in Fig. 3 represent a merge construction? Please list all sets of tasks that apply.

Answer:
7, 8 and 12; 14 and 16.

When concurrent tasks are not dependent on the occurance of one single task, dummy tasks may be used.



Concurrent Tasks with Different Dependencies

In the illustration, tasks 1 and 2 may occur simultaneously as may tasks 3 and 4. Before task 3 may occur, however, tasks 1 and 2 must occur. This condition is illustrated by the broken line (denoting a *dummy task*).

Before continuing, please answer the following questions about types of network construction to test your understanding of the ideas presented.

Which tasks in Fig. 3 must occur before task 11 can occur? Which tasks must occur before task 17 can occur? (Do *not* refer to Fig. 2 before answering.)

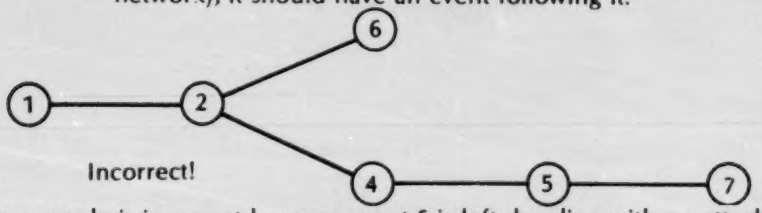
Answer:
Before task 11 can occur, tasks 9 & 10 must occur;
before task 17 can occur, tasks 13, 14, & 16 must occur.

In addition to information about types of network construction, you also must learn the rules of network construction. A synopsis of such rules is presented in Figure 5, Rules for Network Construction.

FIGURE 5. RULES FOR NETWORK CONSTRUCTION

There are four basic "rules" to remember in constructing your PERT network. Violation of these rules will cause you much confusion and will invalidate the procedure.

- Rule 1: Only one activity can occur between events.
- Rule 2: An event can occur only once in the network.
- Rule 3: Action proceeds from left to right. You cannot return to an event once it is completed.
- Rule 4: Unless an event is an end event (located at far right of the network), it should have an event following it.



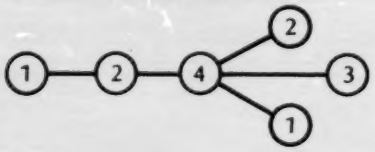
Incorrect!

This example is incorrect because event 6 is left dangling with no attachment to the rest of the network. As it now appears, event 6 is not necessary for the completion of the project. If this should occur in your network, reanalyze your preceding events and eliminate number 6 if it is not needed. If it is needed, redesign your network so that it properly reflects continuing project activity.

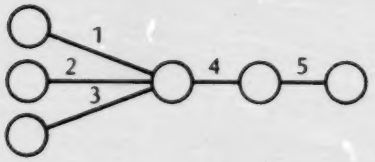
Before continuing, please test yourself on the rules for network construction by answering the questions below.

Place a check beside the items below represents *correct* network construction.

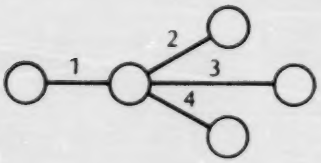
a.



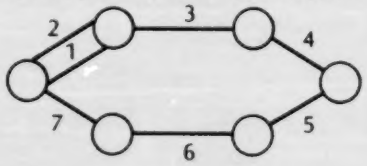
b.



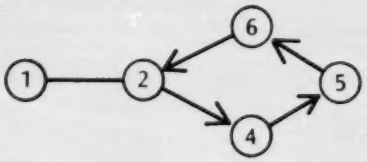
c.



d.



e.



Answer:
b. and c. Item a. is incorrect because event 2 occurs twice; item d. is incorrect because two tasks (1 & 2) occur between two events; item e. is incorrect because event 5 loops back or returns to event 6 and event 5 loops back to event 2.

Now that you are familiar with the types of network construction and the rules of network construction, you are ready to design your own network.

Activity 6: Estimate Task Times. Once this network of tasks or events is complete, you are ready to estimate the time requirements for completing each task or reaching each milestone. In this discussion and your work in estimating task times, times are designated by t_e. Time in PERT is normally represented in weeks which is based on five workdays. Fractions of weeks are displayed in tenths. Thus, 1/2 day would be represented as .1 on the network. One day whould be shown as .2.

Unless time is fixed for some reason such as conference dates or completion dates, three time estimates are normally used in estimating probable task completion times.

- *Most likely time* (m) — the most realistic estimate of when an activity could be completed.
- *Optimistic time* (a) — assuming all went well or better than expected
- *Pessimistic time* (b) — assuming all went badly or worse than expected.

These three estimates fit into a formula for computing t_e or the elapsed task time. The formula is as follows:

$$t_e = \frac{(a + 4m + b)}{6}$$

This formula provides the best estimate of probable tasks completion time. It is most useful when optimistic and pessimistic time estimates differ markedly from most likely time estimates. When all three estimates are very similar, you may dispense with the formula and use the most likely time estimate.

If you decide to use the formula, it will be helpful for you to organize your tasks, times and calculations in chart form like the one below.

Task *a* *b* *m* t_e

Please review Figure 6, Task Time Estimates for Program Evaluation, for the calculation of time estimates for the network depicted in Fig. 3.

FIGURE 6.
TASK TIME ESTIMATES
FOR PROGRAM EVALUATION

Task Number	*a*	*b*	*m*	t_e
1 (1-2)	.1	1	.2	3.2
2 (2-3)	.1	.6	.2	.3
3 (3-4)	.4	2	1	1.1
4 (4-5)	.6	2	1	.8
5 (5-6)	.2	1	.6	.6
6 (6-7)	.1	.4	.2	.2
7 (7-13)	.4	1	.6	.6
8 (6-13)	.1	1	.6	.6
9 (6-11)	1	3	2	2
10 (6-10)	1	3	2	2
11 (11-12)	.2	.6	.4	.4
12 (12-13)	.6	2	1	1.1
13 (13-14)	.1	.1	.1	.1
14 (13-16)	.4	2	1	1.1
15 (13-15)	1	3	2	2
16 (15-16)	.4	1	.7	.7
17 (16-17)	.6	2	1	1.1
18 (17-18)	.6	2	1	1.1
19 (18-19)	1	2	1.4	1.4

Refer to the example depicted below. Complete the t_e calculations for tasks 4 and 5 using the t_e formula.

Task	*a*	*b*	*m*	t_e
1	.2	.4	.3	.3
2	1	4	2	2.2
3	2	5	3	3.2
4	1	7	3	___
5	3	6	4	___

Answer: Task 4, 3.3; Task 5, 3.5.

When it is possible to do so, obtain time estimates from persons who have performed similar work in the past. Never hesitate to obtain estimates from others who have more experience with the work to be performed than you. If you know that a particular person tends to give overly optimistic or pessimistic time estimates you may need to correct for them. Even at that, your corrected estimate is apt to be more accurate than trying to develop one on your own.

Activity 7: Calculate Expected Event Completion Times (T_E). An expected event completion time (T_E) is defined as the total amount of time required to reach an event. When the T_E occurs at the last event, this represents the total amount of time required for project completion.

Event completion times are calculated from left to right by simply adding cumulatively as you proceed through the network. T_E's are normally written over the event on the network for clarity.

Where there are several paths to an event, always choose the path consuming the greatest amount of time in completing this calculation.

Figure 7, PERT and Time Calculations for the Example, illustrates event completion calculations. This is the same PERT network used in Fig. 3 and illustrates what a program evaluation project PERT network might look like. Notice that in Fig. 7, events/milestones have been numbered instead of activities. You may use either method depending on which is more clear and convenient for you.

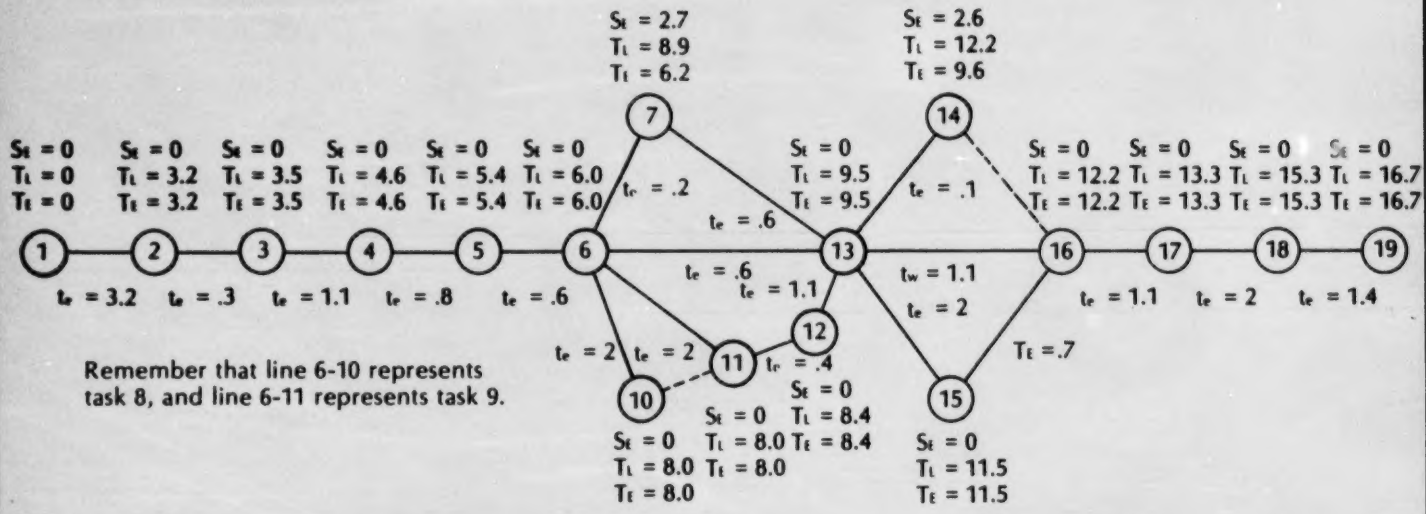
Tasks in Fig. 7 have been designated by the numbers of the events which the tasks connect. Tasks listed in Fig. 6 have been renumbered in Fig. 7 using this system. Notice, for example, in Fig. 6 that task number 8 is represented by the line 6-13 in Fig. 7 In other words, task 8 *is* the line that connects events 6 and 13. Task 9 in Fig. 7 is represented by the line that connects events 6 and 11.

Locate the following tasks in Fig. 7 before continuing:

a. Task 11
b. Task 18
c. Task 8

Activity 8: Calculate the Latest Allowable Completion Time for Each Event. The latest allowable completion time (T_L) is the latest possible time by which the event should occur to avoid a delay in the entire project. To calculate T_L start at the end (far right) of the network with the end event. From the T_L of this event, subtract the t_b of the task leading to it (the task to the immediate left). As you calculate the T_L's write the value above the event.

FIGURE 7.
PERT
AND TIME CALCULATIONS
FOR A PROGRAM
EVALUATION PROJECT



Remember that line 6-10 represents task 8, and line 6-11 represents task 9.

Continue working your way backward through the network until the T_L for event 1 has been calculated. Where there is more than one task leading simultaneously to an event, subtract the larger t_e value.

Refer to Fig. 7. The T_L for event 18 is figured by subtracting the t_e for task 18-19 (1.4) from the T_L for event 19 (16.7). the $_L$ for event 18 is then 15.3.

How would you calculate the T_L for event 13?

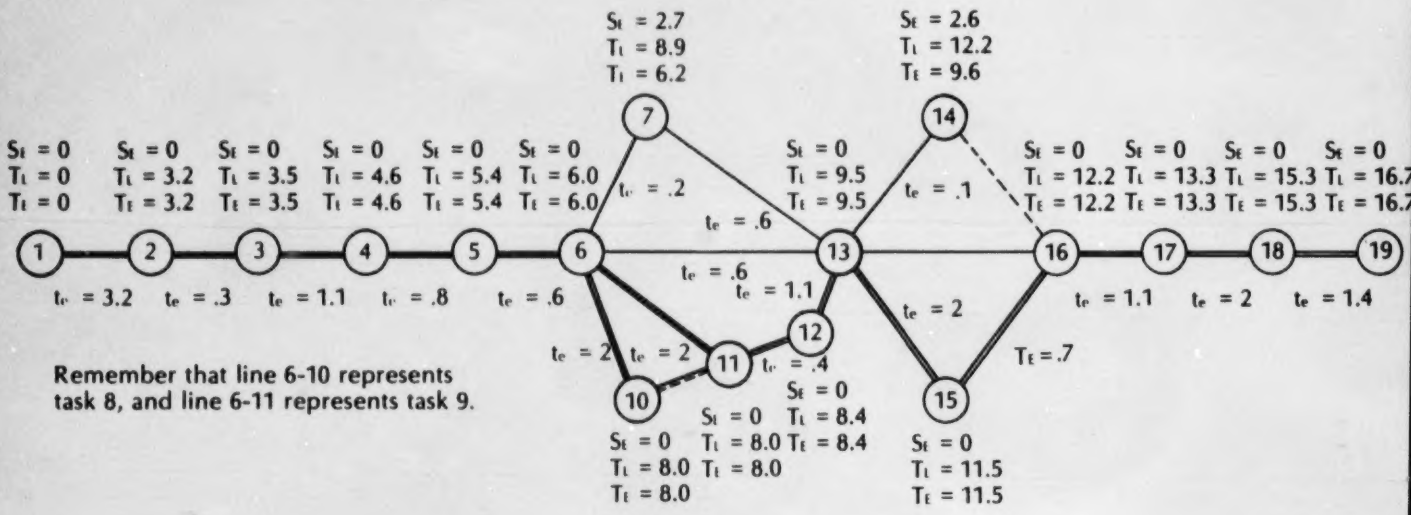
Answer:
Subtract t_e of Task 13-15 (2) from the T_L of event 15 (11.5), giving a T_L for event 13 of 9.5.

Activity 9: Calculate Slack Time for Each Event. Slack time is defined as the difference between the latest time by which an event must be completed and the earliest time that it could be completed without disrupting the project. The operation involved is simply subtracting T_E from T_L at *each* event. The result is S_E which is entered above the event. S_E represents the amount of delay that is acceptable without disrupting the project schedule. The T_E, T_L and S_E are assumed to be zero for event 1.

Activity 10: Find the Critical Path. The critical path represents a series of tasks in which no delays can occur if the project is to be completed on time. Events with a slack (S_E) of zero are connected by tasks which form the critical path.

The critical path in the network is represented by double lines. See Fig. 8 for an illustration. The critical path goes through all critical tasks and events. A delay in any task or event along the critical path will delay the entire project. As an administrator responsible for timely project completion, you will want to monitor and control these events very carefully.

FIGURE 8.
PERT
AND TIME CALCULATIONS
FOR A PROGRAM
EVALUATION PROJECT



Remember that line 6-10 represents task 8, and line 6-11 represents task 9.

Remember that we defined slack time as the difference between the earliest time that an event can be reached and the latest time an event can occur without disrupting the entire project. Slack tells you how long an event can linger without delaying the project. Since a *critical event* has a slack of zero, it cannot be delayed without disrupting the project.

Refer to event 7 in Fig. 8. The slack for this event is 2.7, meaning that although the event could be completed in 6.2 weeks, those responsible for the task actually have the flexibility to complete it in 8.9 weeks if necessary and not cause a delay in the entire project.

In one respect, slack represents a waste of resources; it is time during which resources are lying idle. While some slack is a cushion against delays, an excess of slack is an indication that things should be tightened up. It is your decision as to whether the amount of risk involved in reducing slack is worth the time savings.

Project delays can be prevented by transferring resources from a non-critical task (tasks with slack) to critical tasks (tasks with zero slack). That is why it is important to know how much slack exists and where it exists. Adjustments can often be made in labor and resource planning, allocation and budgeting.

Activity 11: Revising the Project. Look again at the slack and critical path in your network. There are several alterations possible at this point in order to "fine tune" your project. The alternatives include:

- Transfer resources from tasks with slack to those without slack. This could have the result of: (1) anticipating and coping with delays before they occur, thereby insuring timely project completion, or (2) finishing the project earlier than scheduled.
- Take resources from those tasks with slack and transfer them to other projects. Before you do this, make sure that all the resources required will be available when needed.
- Redesign your project. Eliminate unnecessary tasks or sequence them differently providing, of course, that you are able to end up with the project that you desire.

What if delays (negative slack) occur in critical tasks? The following suggestions may help you to overcome these difficulties.

- Channel additional resources from outside into the project. Determine first whether the time savings will justify the increased cost.
- Omit tasks. If your project contains tasks which are "nice to have" but not absolutely essential, you may be able to remove them without severely affecting the project outcome.
- Redefine tasks. Sometimes a task is defined in broad terms requiring a large amount of effort. In such cases, you may be able to break the task down into smaller tasks and by eliminating some of them, reduce time and effort required.
- Narrow the scope of the project. Reduce goals and/or reduce the amount of work required.
- Reduce the quality requirements.
- Rearrange the sequence of tasks. Where a particular sequence is not essential, you can change it.
- Initiate a task before a preceding one is complete.
- Offer incentives to get the work done.
- Seek advice from others who have coped successfully with the kinds of problems you are facing.

Activity 12: Set Up a Calendar of Events and Tasks. Start with event 1 and proceed throughout the network placing calendar dates by each event. A dated event T_L will give you the latest allowable completion date for that event. Task times (t_e's) will tell you how long each task can last, thus assisting you in assigning calendar dates to events.

There may be a certain imposed or directed calendar date on your project. If it is funded by an outside agency, there may be the requirement that the project start and end on a particular date. In such cases, you may have to alter your project design to comply with these requirements.

Over your estimates of T_E, T_L and S_E you may wish to insert scheduled time for events. Scheduled time for tasks (t_s) may be included as well as scheduled earliest expected date (E_S) and scheduled latest allowable date (E_S) for events. These may be calculated in the same way that T_E's, T_L's and t_e's were calculated for tasks and events. The value of these scheduled dates may depend on imposed time constraints from other sources (such as funding agencies) or the known availability of time, people, equipment, buildings and other resources. If you know that some departments tend to give optimistic or pessimistic estimates, you may wish to correct for that in your estimates.

By monitoring your project activity often (sometimes this needs to be done daily) you may prevent delays. Send out memos or some other kind of reminder to those responsible for project activity well in advance of the scheduled completion time for that activity. Reminder dates can easily be fed into the program when the calculations are done by computer.

Activity 13: Cost Estimates. Once time estimates have been determined for activities in the PERT network, you may wish to include cost estimates. The technology for projecting costs in PERT is not as sophisticated as that for time estimates but realistic estimates can be made if project activity is grouped logically. It is too burdensome and time-consuming to project cost for each activity, particularly if the network is large. Instead you should estimate cost by the level 3 units of the work breakdown structure derived in Activity 2. Refer to Fig. 1 for a graphic display of work task levels.

These tasks correspond to tasks in the PERT network and are grouped according to level of specificity. Figure 9 is an example of how cost estimates are applied to work activity breakdown. Note that the design phase has been costed at $410.

Develop a sample level 3 cost breakdown for level 2, instrument development. What items would you suggest are appropriate expenses and how much would you estimate that each item would cost?

_____

_____

_____

_____

_____

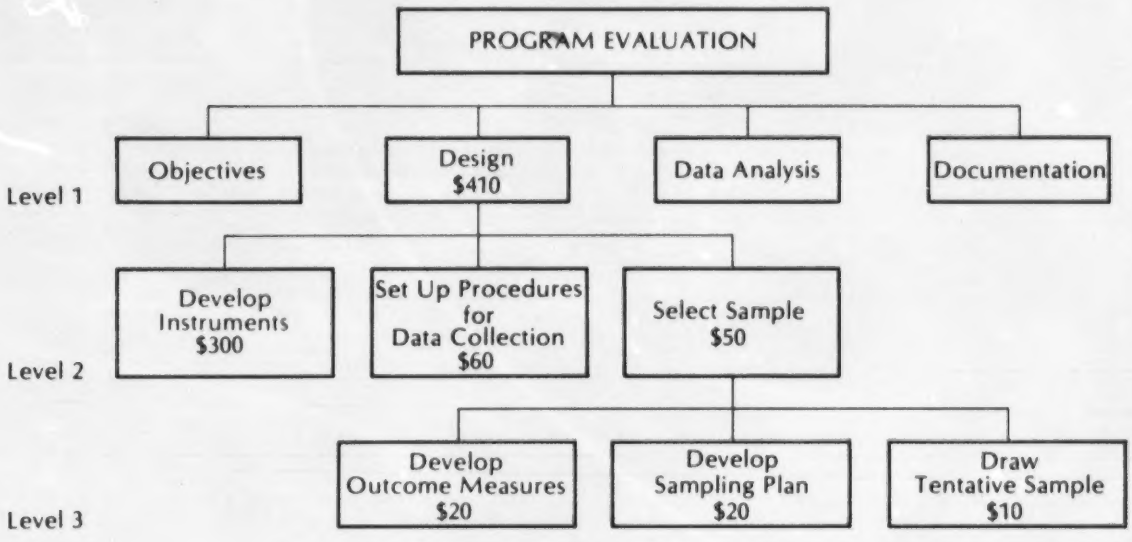
Possible elements:
$45 item construction
$15 design of format
$20 development of instructions
$30 field test
$50 revision
$40 typing and reproduction

_____

You are now ready to develop your own cost estimates using a work breakdown structure relevant to your PERT network. Remember to add from the bottom up in computing total project costs.

It is also possible to include actual costs, as activities are completed, and compare these to projected costs. In so doing, you can determine how far on or off budget you are at any given point in the project and apply corrective measures, shift resources or apply more resources as the situation demands.

FIGURE 9. PERT COST ESTIMATES



Activity 14: Forecasting Outcomes. Somewhat more involved than the previous calculations is the process of forecasting outcomes with PERT. PERT contains a probability capability which, through the application of appropriate formulas, provides a probability estimate of each event being completed on time and within projected cost. However, it is beyond the scope of this self-instructional unit to include this dimension of PERT. If you wish to use PERT in this way, refer to the detailed discussion and how-to description by D. L. Cook entitled *Program Evaluation and Review Technique: Applications in Education*, U.S. Government Printing Office, 1966.

ADDITIONAL RESOURCES

A number of reference works are available as resource documents for learning more about PERT. The following five documents are recommended for your consideration. Brief annotations of each have been included.

Cook, D.L. *Program Evaluation and Review Technique: Applications in Education.* Washington, D.C.: U.S. Government Printing Office, 1966.

A very readable step-by-step guide to PERT calculations, network construction, probability estimation and cost projections. Includes numerous examples of networks and easy to follow instructions.

Davis, Russel G. *Pla. ning Human Resources Development. Chicago:* Rand McNally & Co., 1966.

Includes in Appendix B a planning example displayed in PERT form. Includes steps in the calculations and network display as well as resources estimation.

Justus, John E. *"PERT: What is it?" School Management.* Vol. XI (12), Dec. 1967, pp. 24-29.

A basic description of PERT and its possible applications in a school setting. Very readable.

Tanner, C. Kenneth. *Design for Educational Planning.* Mass: D. C. Heath & Co., 1971.

Includes a detailed, although highly technical, discussion of PERT, steps in its application and examples. Also includes steps for computing probability estimates and suggested computer applications.

Turban, Efraim & Jack R. Meredith, *Fundamentals of Management Science.* Texas: Business Publications, Inc., 1977.

Must reading for the hard-core PERT user. Although the language is somewhat technical and the examples are from business, the material is organized well and the steps are so well outlined that they are easy to follow in spite of the examples used.

GLOSSARY OF PERT TERMS

Helpful in understanding the PERT process is a definition of terms used in conjunction with its operation and application. The following terms were used and most were defined and illustrated at least once in the text.

Task—an effort which requires time and resources for completion.

Event/milestone—signifies the end or beginning of a task but does not consume time. In order to reach an event/milestone, all previous tasks must be completed. Can be viewed as a goal whereas tasks leading to it can be seen as means for reaching the goal.

Project/program—a graphic illustration or set of tasks showing their relationships in time.

Network—a graphic illustration of a set of tasks showing their relationships in time.

Path—a series of adjacent tasks leading from one event to the other.

Slack—the difference between the time by which the task must be completed and the earliest time the task could be completed.

Critical task—a task, which if delayed, will hold up project completion.

Critical path—a collection of critical tasks and events that form a continuous, uninterrupted path between a project's beginning and its end; a series of events for which there is no slack time; each must be completed on time if the project is to be completed on time.

Dummy task—shows a connection between two events that requires no consumption of time (aside from that required in reaching the two events) and no resource consumption. Both events, however, must be reached before subsequent tasks can occur. These are represented graphically in the network by a dotted line connecting two tasks.

Elapsed time—(E_T) the point at which all components of a task have been completed, including in addition to the work itself, information dissemination, waiting time, and so forth.

Expected event time—(T_E) amount of time an event is expected to require, computed in terms of the longest path from the start of the project to the event in question.

Latest allowable completion time—(T_L) the latest time by which an event must occur if it is not to disrupt the prompt completion of the project.

Event slack—(S_L) the amount of acceptable delay in reaching an event.

Concluding Activity

After you have completed reading the desired sections of this booklet, please return to the *Guide* and continue your work in that document.

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